

**Wyoming Department of Environmental Quality-Water Quality Division**  
**Watershed Monitoring Program**  
**Green River Probabilistic Survey**  
**Sampling and Analysis Plan - February 2015 (revised June 24, 2015)**

**BACKGROUND**

**Probabilistic Rotating Basin Surveys**

Probabilistic rotating basin surveys (PRBS) are used to accomplish the primary objectives of the Wyoming Surface Water Quality Monitoring Strategy (WDEQ 2010). PRBS involve sampling a randomly selected subsample of the population of interest, similar to a census, to make broader conclusions about the population as a whole. Wyoming uses a customized generalized random tessellation-stratified (GRTS) survey design using the National Hydrographic Dataset (NHD) as the base sample frame (see [http://www.epa.gov/nheerl/arm/documents/presents/grts\\_ss.pdf](http://www.epa.gov/nheerl/arm/documents/presents/grts_ss.pdf); Stevens and Olson, 2004). The customized GRTS design involves a random selection of 50 primary sites on perennial, non-headwater (>1<sup>st</sup> Strahler order) rivers and streams outside of national parks, congressionally-designated wilderness areas and the Wind River Reservation within each of five 'superbasins.' The five superbasins were delineated based on combinations of 6-digit (3<sup>rd</sup> level) Hydrologic Unit Codes (HUC) and geographical location. The five superbasins and the associated HUC 6 basins they represent are:

Bighorn/Yellowstone [Bighorn and Yellowstone Basins]- PRBS completed in 2010

Northeast [Belle Fourche, Cheyenne, Little Missouri, Powder and Tongue Basins]- PRBS completed in 2011

**Green [Great Divide, Green and Little Snake Basins]- PRBS scheduled for 2015**

Platte [Niobrara, North Platte and South Platte Basins]- PRBS scheduled for 2016

Bear/Snake [Bear and Snake Basins]- PRBS schedule to be determined

Site selection is further stratified into aggregations of 8-digit (4<sup>th</sup> level) HUCs, or "HUC 8 clusters," within each superbasin. The additional stratification helps achieve more equal spatial allocation of the 50 primary sites among all HUC 8 clusters and across a superbasin. Following the same design, a population of 100 oversample sites (also stratified by HUC 8 cluster) is generated for each superbasin to be used as replacements when a primary site cannot be sampled. Oversample sites are only used as replacements for primary sites occurring within the same HUC 8 cluster to maintain representativeness and minimize logistical complexities of sampling. Data from the 50 sites ultimately sampled within each superbasin are used to make statistical inferences of the water quality condition within each superbasin, including the proportion of target stream miles likely achieving water quality standards or statistically derived expected conditions, and the occurrence, extent and relative risk of various pollutants. Data from PRBS are not used to make determinations of designated use support or resultant categorization decisions in the Integrated Report. PRBS data are used to identify waters of high quality and those where designated use-support may be limited, and thus are candidates for future targeted monitoring for determinations of designated use support. These streams will be screened using a multi-factor prioritization strategy to determine if targeted monitoring will be conducted.

**MONITORING OBJECTIVES**

The objectives of the Green River PRBS are 1) objectively evaluate water quality conditions within the Green River superbasin, including the proportion of target stream miles likely achieving water quality standards or statistically derived expected conditions, and the occurrence, extent and relative risk of various pollutants, and 2) identify both high quality and low quality waters that are candidates for future targeted monitoring for determinations of designated use support.

**CREDIBLE DATA**

All data are collected with the intent to address the credible data law specified in the Wyoming Environmental Quality Act § 35-11-302 (b)(i) and (b)(ii).

## **SAMPLING**

### Study Design

The study design follows the GRTS approach described above. Specific details for the Green River PRBS include:

- A) The Green River superbasin is divided up into three HUC8 clusters: Upper Green-New Fork, Big Sandy-Blacks Fork-Muddy, and Lower Green-Little Snake-Great Divide
- B) 50 primary sites and 100 oversample sites are divided between the three HUC8 clusters
- C) First order streams, and all streams within the Bridger Wilderness are excluded from the survey

### Monitoring Locations

See Appendix A for a complete list of primary and oversample sites. See Figure 1 for a map of all primary and oversample sites.

### Sites Requiring Private Land Access

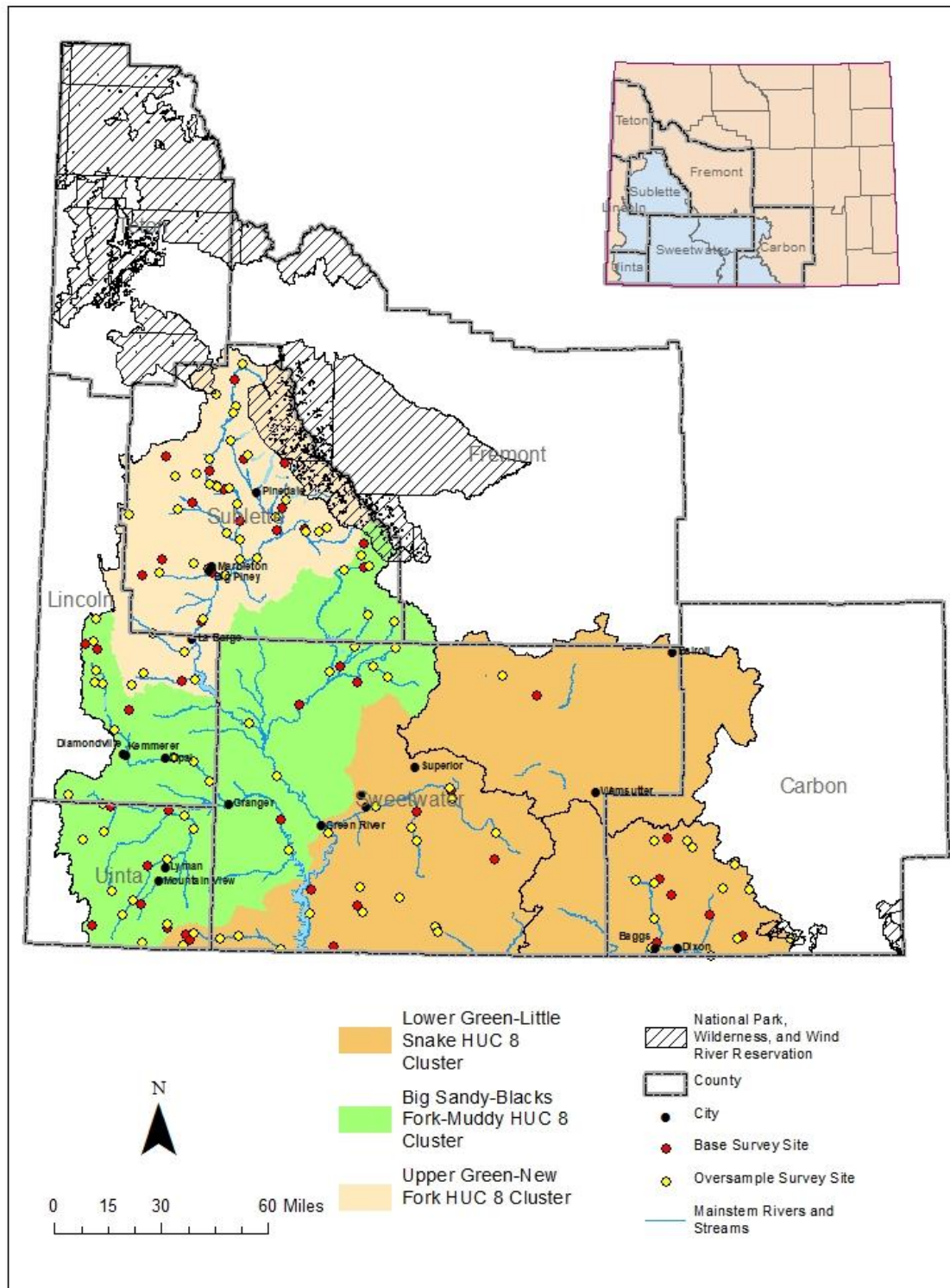
All field personnel will follow the SOP for Private Lands Access

### Field Personnel

Cheyenne field office staff: Eric Hargett (307-777-6701) or Lanny Goyn (307-777-6353)

Lander field office staff: Tavis Eddy (307-335-6957) or Mike Wachtendonk (307-335-6751)

Figure 1. Primary and oversample used for the Green River probabilistic rotating basin survey.



### Sample Parameters and Methods

| Parameter                                      | Sample Method / SOP**                                       | Reporting Units RU   | Analytical Method / SOP   | Preservative  | Holding Time                   | Reporting Limit |
|--|---|----------------------|---|---|--------------------------------|-----------------|
| <b>Chemical</b>                                |   |                      |   |   |                                |                 |
| Alkalinity, Total (as CaCO <sub>3</sub> )      | Grab  | mg/L                 | SM2320B   | Iced  | 14 days                        | 10              |
| Ammonia, as N                                  | Grab  | mg/L                 | SM4500-NH4D   | 1:1 H <sub>2</sub> SO <sub>4</sub> ; Iced                                   | 28 days                        | 0.10            |
| Ca and Na, Dissolved                           | Grab  | mg/L                 | E200.7/200.8  | 1:1 HNO <sub>3</sub> , Iced   | 6 months                       | 0.20            |
| Chlorides, Total                               | Grab  | mg/L                 | E 300.0   | Iced  | 28 days                        | 1.0             |
| Conductivity                                   | DM  | µS/cm                | SM2510-B  | None; FM  | N/A                            | 0.10            |
| Se (total), As, Cd, Zn, Al, Fe, Mn (dissolved) | Grab  | µg/L                 | E200.7/200.8  | 1:1 HNO <sub>3</sub> , Iced   | 6 months                       | 1.0             |
| Dissolved Oxygen (DO)                          | DM  | mg/L; % sat.         | ASTM D 885-05 / A4500-O(G) /E360.1  | None; FM  | N/A                            | 0.01            |
| Hardness, Total (as CaCO <sub>3</sub> )        | Grab  | mg/L                 | SM2340 B  | 1:1 HNO <sub>3</sub> , Iced   | 6 months                       | 1.00            |
| Nitrite-Nitrate, as N                          | Grab  | mg/L                 | E353.2  | 1:1 H <sub>2</sub> SO <sub>4</sub> ; Iced                                   | 28 days                        | 0.05            |
| Nitrogen, Total                                | Grab  | mg/L                 | SM4500-N B  | 1:1 H <sub>2</sub> SO <sub>4</sub> ; Iced                                   | 28 days                        | 0.10            |
| pH   | DM  | S.U.                 | SM4500-H <sup>+</sup>   | None; FM  | N/A                            | 0.01            |
| Phosphorus, Total                              | Grab  | mg/L                 | E365.3  | 1:1 H <sub>2</sub> SO <sub>4</sub> ; Iced                                   | 28 days                        | 0.10            |
| Sulfates, Total                                | Grab  | mg/L                 | E300.0  | Iced  | 28 days                        | 0.10            |
| Temperature, Water                             | DM  | C°                   | SM2550  | None; FM  | N/A                            | 0.01            |
| Total Suspended Solids                         | Grab  | mg/L                 | SM2540D   | Iced  | 7 days                         | 1.0             |
| Herbicides and Pesticides                      | Grab  | µg/L                 | E507m, E515.1, E531.1, E547.0   | All: Iced<br>E531.1: 1.2ml monochloroacetic acid                            | 14 days;<br>28 days for E531.1 | 1.0 - 10        |
| <b>Biological</b>                              |   |                      |   |   |                                |                 |
| Chlorophyll a                                  | See SOP for <i>Periphyton Sampling</i>                      | mg/m <sup>2</sup>    | SM10200H  | 99% Ethyl Alcohol, iced; see SOP for <i>Periphyton Sampling</i>             | 21 days                        | 0.10            |
| Macroinvertebrates                             | See SOPs for <i>Macroinvertebrate Sampling</i>              | Raw counts & Density | SOP for <i>Macroinvertebrate Sample Identification</i>  | 99% Ethyl Alcohol; see SOP for <i>Macroinvertebrate Sample Preservation</i> | Indefinite                     |                 |
| Periphyton                                     | See SOP for <i>Periphyton Sampling</i>                      | Raw counts & Density | SOP for <i>Periphyton Sample Identification</i>   | 5-10% Lugol's; see SOP for <i>Periphyton Sampling</i>                       | Indefinite                     |                 |
| E. coli bacteria                               | See SOP for Coliform Bacteria Sampling Procedure            | CFU/100ml            | See SOP for <i>Escherichia coli &amp; Total Coliform Bacteria Colilert®-Defined Enzyme Substrate Method</i> | Iced  | 8 hours                        | 1 CFU/100ml     |
| <b>Physical</b>                                |   |                      |   |   |                                |                 |
| Bank stability & cover                         | See SOP for <i>Monitoring Procedure Sequence (standard)</i> | N/A                  | N/A   | N/A   | N/A                            | N/A             |
| Channel type, Rosgen                           | See SOP for <i>Rosgen Channel Type Classification</i>       | N/A                  | N/A   | N/A   | N/A                            | N/A             |

|  |   |     |   |          |     |      |
|--|---|-----|---|----------|-----|------|
| Cross-sections, Riffle   | See SOP for <i>Channel Cross-section – Survey Method</i>          | N/A | N/A   | N/A      | N/A | N/A  |
| Discharge  | See SOP for <i>Stream Discharge</i>                               | cfs | See SOP for <i>Stream Discharge</i>                               | None; FM | N/A | 0.01 |
| Gradient, Riffle and Reachwide                                       | See SOP for <i>Reachwide and Riffle Gradients – Survey Method</i> | N/A | See SOP for <i>Reachwide and Riffle Gradients – Survey Method</i> | N/A      | N/A | N/A  |
| Qualitative riparian vegetative structure and human influence survey | See SOP for <i>Monitoring Procedure Sequence (standard)</i>       | N/A | N/A   | N/A      | N/A | N/A  |
| Qualitative stream and riparian condition survey                     | See SOP for <i>Monitoring Procedure Sequence (standard)</i>       | N/A | N/A   | N/A      | N/A | N/A  |
| Qualitative reach and watershed characterization                     | See SOP for <i>Monitoring Procedure Sequence (standard)</i>       | N/A | N/A   | N/A      | N/A | N/A  |
| Substrate, Riffle  | See SOP for <i>Macroinvertebrate Sampling</i>                     | mm  | See SOP for <i>Macroinvertebrate Sampling</i>                     | N/A      | N/A | 0.10 |
| Substrate, Reachwide   | See SOP for <i>Pebble Counts, Reachwide and Cross-sections</i>    | mm  | See SOP for <i>Pebble Counts, Reachwide and Cross-sections</i>    | N/A      | N/A | 0.10 |

DM = Direct Measurement; FM = Field Measurement; \*Field filtered through 0.45 µm gf/f; \*\* WDEQ 2011. Manual of standard operating procedure for sample collection and analysis. Wyoming Dept. of Environmental Quality, Cheyenne, WY; can be accessed at <http://deq.wyoming.gov/wqd/qaqc/resources/manual/>.

## QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

### Data Recording

All data and information collected in the field will be recorded on official Field Data Sheets (see SOP for *Monitoring Procedure Sequence (standard)*).

Samples for laboratory analysis will be recorded on official chain of custody forms (see SOP for *Chain of Custody*).

### Data Verification and Validation

See SOPs for *Data Validation* and *Data Verification* along with the Qa/Qc process flow chart (Appendix C).

### Field Quality Control (QC) for Chemical Samples

| Field Qc Samples | Collection Frequency  | Parameters            |
|------------------|---|-----------------------|
| Trip Blank       | One on the day of and prior to travel to the Green River PRSB study area (typically one per week) | All listed, except FM |
| Field Blank      | One for every 10 samples collected  | All listed, except FM |
| Duplicate        | One for every 10 samples collected  | All listed            |

See SOP for *Quality Control Measures, Summary of*

### Equipment (Electronic) Calibration, Maintenance and Calibration Logs

| Item   | Calibration  | Calibration Check  | Maintenance   | Calibration Log  |
|--|--|--|---|--|
| pH meter – Hydrolab MS5 or Hanna 9023 or 9025C                 | Once daily pH 7 and 10 standards                       | Once daily at end of sampling event with pH 7 standard             | Re-condition according to owner's manual. Remove precipitate/debris and keep probe bulb moist | See SOP for <i>Instrument Calibration and Calibration Logs</i> |
| Conductivity meter – Hydrolab MS5 or Hanna 9033                | Once daily using a standard appropriate to the setting | Once daily at end of sampling event using the calibration standard | Re-condition according to owner's manual. Remove precipitate/debris                           | See SOP for <i>Instrument Calibration and Calibration Logs</i> |
| D.O. meter – Hydrolab MS5 (optical) or YSI 95/10 or Orion 810A | Once daily or with each 200 ft change in elevation     | None   | Re-condition according to owner's manual. Remove precipitate/debris and keep probe bulb moist | See SOP for <i>Instrument Calibration and Calibration Logs</i> |
| Flow meter – Marsh-McBirney                                    | Once annually  | None   | Remove precipitate/debris   | See SOP for <i>Instrument Calibration and Calibration Logs</i> |

## **LABORATORIES**

The following laboratories will provide analytical services for samples collected as part of the project described in this SAP:

1. Wyoming Department of Environmental Quality, Water Quality Division Laboratory (WQD lab)

The WQD lab will be the primary provider of analytical services for water samples collected as part of this project. The WQD lab will provide customized packages of bottles, labels, preservatives, and chain of custody forms prior to samples being collected as requested by samplers. Samplers will either hand deliver or ship samples to the WQD lab using United Parcel Service or Federal Express. The WQD lab will analyze samples in accordance with established standards for holding time, analytical method, and data quality assurance and control. Results of analyses typically will be returned to samplers within 30 days of receipt of samples by the WQD lab. The WQD lab will follow the Watershed Program standard operating procedures and QAPP (<http://deq.wyoming.gov/wqd/qaqc/>).

2. Energy Laboratories, Inc. (ELI)

ELI has provided analytical services to the Watershed Program since 2006, and is under contract with the Watershed Program through 2016.

ELI-Casper will analyze herbicides and pesticides and also may analyze split samples for select parameters. Samplers will either hand deliver or ship samples to ELI using United Parcel Service or Federal Express. ELI-Casper will analyze samples in accordance with industry standards for holding time, analytical method, and data quality assurance and control. The ELI-Casper Quality System including the quality assurance manual, qualifications manual, NELAP and other

certifications, and performance evaluation certificates is available at:  
<http://www.energylab.com/QualityControl.asp>

### 3. Rhithron Associates (Rhithron)

Rhithron will provide taxonomic identification services for macroinvertebrate and periphyton samples collected as part of this project. Rhithron has provided taxonomic services to the Watershed Program since 2004 and is under contract through June 30, 2016. Preserved macroinvertebrate and periphyton samples will be sent to Rhithron at the end of the field season. Rhithron will provide results to samplers within 90 days of receipt of samples. Rhithron will subsample, sort and identify specimens according to contract terms and the SOP for Macroinvertebrate Sample Identification. Established standards for taxonomic identification will be followed. Rhithron quality system documentation is available from Rhithron upon request.

## DATA

### Data Management

| Data Type                     | Storage  | Location                     |
|-------------------------------|--|------------------------------|
| Chemical                      | SWM 2.0 database<br>Spreadsheet and .pdf                         | WDEQ/WQD Cheyenne and Lander |
| Biological, Macroinvertebrate | SWM 2.0 database<br>Spreadsheet and .pdf                         | WDEQ/WQD Cheyenne and Lander |
| Biological, Periphyton        | Algal database<br>Spreadsheet and .pdf                           | WDEQ/WQD Cheyenne and Lander |
| Physical, Survey              | Rivermorph 4.3<br>SWM 2.0 database (summary only)<br>Spreadsheet | WDEQ/WQD Cheyenne and Lander |
| Physical, Other               | SWM 2.0 database<br>Spreadsheet                                  | WDEQ/WQD Cheyenne and Lander |

### Data Archiving

| Data Item   | Format  | Backup Copy & Format                                | Location                        | Retention |
|---|---|---|---------------------------------|-----------|
| Field Data Sheets   | Paper   | None  | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Photographs   | Electronic (.jpg and .wpd) & Paper                  | Electronic (.jpg and .wpd)                          | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Field Log Books   | Paper   | Paper   | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Laboratory Results/Qa                                     | Electronic (.pdf) & Paper                           | Electronic (.pdf) & Paper                           | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Agency Qa Reports   | Electronic (.wpd and .pdf) & Paper                  | Electronic (.wpd and .pdf) & Paper                  | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Calibration Logs  | Paper   | None  | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Chain of Custody Forms                                    | Electronic (.xlsx) & Paper                          | Electronic (.xlsx) & Paper                          | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Spreadsheets, other electronic storage and analysis files | Electronic (.xlsx, .rmp, .txt, .dbf, other) & Paper | Electronic (.xlsx, .rmp, .txt, .dbf, other) & Paper | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Database  | Electronic (.mdb, other)                            | Electronic (.mdb, other)                            | WDEQ/WQD<br>Cheyenne and Lander | Permanent |
| Reports, emails, letters                                  | Electronic (.wpd, .pdf, .html) & Paper              | Electronic (.wpd, .pdf, .html) & Paper              | WDEQ/WQD<br>Cheyenne and Lander | Permanent |

-All records are the property of the State and therefore subject to the Wyoming Public Records Act.

-Records may be transferred to the Wyoming State Archives according to procedures in the Wyoming Records Management Manual.

### Site-Specific Data Analysis

Analytical methods for this study include but are not limited to the following:

| <b>Data Type</b>                             | <b>Analytical Method</b>                          | <b>Analysis Description</b>   |
|--|---|---|
| Chemical, all                                | Wyoming Water Quality Standards (WDEQ/WQD 2013)   | Compare to State acute and chronic numeric criteria.  |
| Biological, Macroinvertebrate and Periphyton | Wyoming Water Quality Standards (WDEQ/WQD 2013)   | Compare to State narrative criteria protective of aquatic life using a weight-of-evidence approach.   |
| Biological, Macroinvertebrate                | WSII (Hargett 2011) and WY RIVPACS (Hargett 2012) | Biocriteria derived from the model output are used to evaluate attainment of Chapter 1, Section 32 with respect to the expected regional reference condition at each monitoring site. |
| Biological, Macroinvertebrate and Periphyton | Metrics   | Selected macroinvertebrate metrics not associated with the WSII and several diatom metrics will be compared to regional reference expectations.                                       |
| Biological, E. coli bacteria                 | Wyoming Water Quality Standards (2013)            | Compare to appropriate single sample criterion in Section 27(c)   |
| Physical, Other                              | WARSSS (Rosgen 2006)                              | Assess whether indicators of excess sedimentation or degradation are present at each site.  |

### REPORT

Superbasin-scale data analysis methods and results are reported in an overall project report that is completed approximately two to three years after completion of sampling. This and reports for previous probabilistic surveys, can be found at <http://deq.wyoming.gov/wqd/surface-water-monitoring/resources/publications/>.

### REFERENCES

Hargett, E.G. 2012. Assessment of aquatic biological condition using WY RIVPACS with comparisons to the Wyoming Stream Integrity Index (WSII). Wyoming Department of Environmental Quality, Water Quality Division, Document #12-0151, Cheyenne, Wyoming. 77 p.

Hargett, E.G. 2011. The Wyoming Stream Integrity Index (WSII) – Multimetric indices for assessment of wadeable streams and large rivers in Wyoming. Wyoming Department of Environmental Quality, Water Quality Division, Document #11-0787, Cheyenne, Wyoming. 101 p.

Rosgen, D.L. 2006. Watershed Assessment of River Stability and Sediment Supply (WARSSS). Wildland Hydrology. Fort Collins, CO.

Stevens, Jr., D.L. and A.R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262-278.

WDEQ/WQD. 2013. Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

WDEQ/WQD. 2011. Manual of standard operating procedure for sample collection and analysis. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

WDEQ/WQD. 2001. Quality Assurance Project Plan (QAPP) for Beneficial Use Reconnaissance Project (BURP) Water Quality Monitoring. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.





**Appendix A – Green River Basin probability survey sites.**

| Site ID | Stream Name         | Type | Longitude  | Latitude | HUC 8 Cluster               | HUC8     | Field Office     |
|---------|---------------------|------|------------|----------|-----------------------------|----------|------------------|
| 201     | Little Muddy Creek  | Base | -110.65863 | 41.57713 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 202     | Sage Creek          | Base | -110.28166 | 41.08169 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 203     | Little Muddy Creek  | Base | -110.61203 | 41.56541 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 204     | Hay Creek           | Base | -109.09009 | 42.35099 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 205     | East Fork Hams Fork | Base | -110.71431 | 42.20094 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 206     |                     | Base | -110.68988 | 41.07666 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 207     | Smiths Fork         | Base | -110.42919 | 41.17236 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 208     | Big Sandy River     | Base | -109.60387 | 42.00298 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 209     | West Fork Hams Fork | Base | -110.78341 | 42.22152 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 210     | Quarry Creek        | Base | -110.40073 | 41.32764 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 211     | Squaw Creek         | Base | -109.26742 | 42.56951 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 212     |                     | Base | -109.29067 | 42.09980 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 213     | Willow Creek        | Base | -110.53121 | 41.95901 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 214     | Little Muddy Creek  | Base | -110.29364 | 41.55656 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 215     | Little Sandy Creek  | Base | -109.38286 | 42.16060 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 216     | Blacks Fork         | Base | -109.68981 | 41.53335 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 217     | Big Sandy River     | Base | -109.27051 | 42.66387 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 218     | Henrys Fork         | Base | -110.18419 | 41.05681 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 219     | Antelope Creek      | Base | -108.52843 | 41.38903 | Lower Green-Little Snake    | 14040105 | Cheyenne         |
| 220     | Muddy Creek         | Base | -107.59057 | 41.47788 | Lower Green-Little Snake    | 14050004 | Cheyenne         |
| 221     | Muddy Creek         | Base | -107.64678 | 41.05350 | Lower Green-Little Snake    | 14050004 | Cheyenne         |
| 222     | Currant Creek       | Base | -109.51675 | 41.25199 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 223     | Bitter Creek        | Base | -108.76998 | 41.66721 | Lower Green-Little Snake    | 14040105 | Cheyenne         |
| 224     | Battle Creek        | Base | -107.18829 | 41.07925 | Lower Green-Little Snake    | 14050003 | Cheyenne         |
| 225     |                     | Base | -108.83129 | 41.10893 | Lower Green-Little Snake    | 14040109 | Cheyenne         |
| 226     | Trout Creek         | Base | -109.25977 | 41.19156 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 227     | Salt Wells Creek    | Base | -108.95398 | 41.58010 | Lower Green-Little Snake    | 14040105 | Cheyenne         |
| 228     | Savery Creek        | Base | -107.35994 | 41.16662 | Lower Green-Little Snake    | 14050003 | Cheyenne         |
| 229     | Poison Creek        | Base | -110.16111 | 41.03195 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 230     | Bear Creek          | Base | -108.30744 | 42.05821 | Lower Green-Little Snake    | 14040200 | Cheyenne         |
| 231     | Cow Creek           | Base | -107.63402 | 41.31221 | Lower Green-Little Snake    | 14050004 | Cheyenne         |
| 232     | Cherokee Creek      | Base | -107.56582 | 41.24870 | Lower Green-Little Snake    | 14050004 | Cheyenne         |

|     |                        |            |            |          |                             |          |                  |
|-----|------------------------|------------|------------|----------|-----------------------------|----------|------------------|
| 233 | Spring Creek           | Base       | -109.38502 | 41.02146 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 234 | Green River            | Base       | -110.01147 | 43.31724 | Upper Green-New Fork        | 14040101 | Lander           |
| 235 | Middle Piney Creek     | Base       | -110.10069 | 42.52875 | Upper Green-New Fork        | 14040101 | Lander           |
| 236 |                        | Base       | -110.09120 | 42.88555 | Upper Green-New Fork        | 14040101 | Lander           |
| 237 | Green River            | Base       | -110.13538 | 42.94296 | Upper Green-New Fork        | 14040101 | Lander           |
| 238 | Green River            | Base       | -110.14855 | 42.33054 | Upper Green-New Fork        | 14040101 | Lander           |
| 239 | South Beaver Creek     | Base       | -110.37892 | 42.99772 | Upper Green-New Fork        | 14040101 | Lander           |
| 240 |                        | Base       | -110.04597 | 42.87175 | Upper Green-New Fork        | 14040101 | Lander           |
| 241 | North Cottonwood Creek | Base       | -110.22276 | 42.81304 | Upper Green-New Fork        | 14040101 | Lander           |
| 242 | South Piney Creek      | Base       | -110.48712 | 42.50938 | Upper Green-New Fork        | 14040101 | Lander           |
| 243 |                        | Base       | -109.95668 | 42.74402 | Upper Green-New Fork        | 14040101 | Lander           |
| 244 | Boulder Creek          | Base       | -109.72770 | 42.80421 | Upper Green-New Fork        | 14040102 | Lander           |
| 245 | Middle Piney Creek     | Base       | -110.38081 | 42.57692 | Upper Green-New Fork        | 14040101 | Lander           |
| 246 |                        | Base       | -110.25038 | 42.08788 | Upper Green-New Fork        | 14040101 | Lander           |
| 247 |                        | Base       | -109.75359 | 42.70769 | Upper Green-New Fork        | 14040102 | Lander           |
| 248 | Willow Creek           | Base       | -109.94146 | 42.99804 | Upper Green-New Fork        | 14040102 | Lander           |
| 249 | Sweeney Creek          | Base       | -109.71501 | 42.98391 | Upper Green-New Fork        | 14040102 | Lander           |
| 250 | East Fork River        | Base       | -109.59537 | 42.71860 | Upper Green-New Fork        | 14040102 | Lander           |
| 651 | Hams Fork Creek        | Oversample | -110.73063 | 42.32575 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 652 | Little Muddy Creek     | Oversample | -110.65985 | 41.57697 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 653 | Blacks Fork            | Oversample | -110.16118 | 41.48611 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 654 | Big Sandy River        | Oversample | -109.37582 | 42.55620 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 655 | Elk Creek              | Oversample | -110.73680 | 42.23683 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 656 | Clear Creek            | Oversample | -110.64595 | 41.46138 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 657 | Blacks Fork            | Oversample | -110.20791 | 41.53963 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 658 | Hay Creek              | Oversample | -109.09209 | 42.34952 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 659 | Hams Fork              | Oversample | -110.16630 | 41.76092 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 660 | Gilbert Creek          | Oversample | -110.41892 | 41.01732 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 661 | Green River            | Oversample | -109.71536 | 41.71262 | Big Sandy-Blacks Fork-Muddy | 14040103 | To be determined |
| 662 | Jack Morrow Creek      | Oversample | -109.20270 | 42.16393 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 663 | Hams Fork              | Oversample | -110.67835 | 42.06170 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 664 | Little Creek           | Oversample | -110.58637 | 41.21957 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 665 | Squaw Creek            | Oversample | -109.23888 | 42.57613 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 666 |                        | Oversample | -109.08221 | 42.24117 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |

|     |                               |            |            |          |                             |          |                  |
|-----|-------------------------------|------------|------------|----------|-----------------------------|----------|------------------|
| 667 | Clear Creek                   | Oversample | -110.75689 | 41.42442 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 668 | Little Sandy Creek            | Oversample | -109.23668 | 42.37538 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 669 | Carter Creek                  | Oversample | -110.84533 | 41.60941 | Big Sandy-Blacks Fork-Muddy | 14040108 | To be determined |
| 670 | Jack Morrow Creek             | Oversample | -109.12566 | 42.12335 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 671 | Horse Creek                   | Oversample | -110.52435 | 41.12779 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 672 | Little Sandy Creek            | Oversample | -109.30884 | 42.24572 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 673 | Blacks Fork                   | Oversample | -110.47577 | 41.18933 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 674 | Big Sandy River               | Oversample | -109.43862 | 42.14210 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 675 | Hams Fork                     | Oversample | -110.72063 | 42.11719 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 676 | Hams Fork                     | Oversample | -110.08167 | 41.68326 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 677 | Hams Fork                     | Oversample | -110.28032 | 41.77328 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 678 | Sage Creek                    | Oversample | -110.28141 | 41.09735 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 679 |                               | Oversample | -110.60558 | 41.87715 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 680 | Blacks Fork                   | Oversample | -109.64333 | 41.41123 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 681 | Wilkinson Creek               | Oversample | -110.72453 | 42.06637 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 682 | Big Sandy River               | Oversample | -109.28162 | 42.61807 | Big Sandy-Blacks Fork-Muddy | 14040104 | To be determined |
| 683 | Blacks Fork                   | Oversample | -110.29655 | 41.36119 | Big Sandy-Blacks Fork-Muddy | 14040107 | To be determined |
| 684 | Green River                   | Oversample | -109.87200 | 41.92206 | Big Sandy-Blacks Fork-Muddy | 14040103 | To be determined |
| 685 | Salt Wells Creek              | Oversample | -108.98163 | 41.51404 | Lower Green-Little Snake    | 14040105 | Cheyenne         |
| 686 | Bitter Creek                  | Oversample | -108.75705 | 41.63377 | Lower Green-Little Snake    | 14040105 | Cheyenne         |
| 687 | Cow Creek                     | Oversample | -107.65870 | 41.29604 | Lower Green-Little Snake    | 14050004 | Cheyenne         |
| 688 | Sage Creek                    | Oversample | -109.25069 | 41.26874 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 689 | Salt Wells Creek              | Oversample | -108.94568 | 41.45786 | Lower Green-Little Snake    | 14040105 | Cheyenne         |
| 690 | North Fork Little Snake River | Oversample | -106.92892 | 41.06948 | Lower Green-Little Snake    | 14050003 | Cheyenne         |
| 691 | Fish Creek                    | Oversample | -107.22756 | 41.37097 | Lower Green-Little Snake    | 14050003 | Cheyenne         |
| 692 | Henrys Fork                   | Oversample | -109.66730 | 41.00443 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 693 | Muddy Creek                   | Oversample | -107.66323 | 41.46821 | Lower Green-Little Snake    | 14050004 | Cheyenne         |
| 694 | Little Snake River            | Oversample | -107.35524 | 41.00365 | Lower Green-Little Snake    | 14050003 | Cheyenne         |
| 695 | East Fork Savery Creek        | Oversample | -107.15005 | 41.26782 | Lower Green-Little Snake    | 14050003 | Cheyenne         |
| 696 | Poison Creek                  | Oversample | -110.19359 | 41.01224 | Lower Green-Little Snake    | 14040106 | Cheyenne         |
| 697 | Bear Creek                    | Oversample | -108.49715 | 42.13423 | Lower Green-Little Snake    | 14040200 | Cheyenne         |
| 698 | Muddy Creek                   | Oversample | -107.75814 | 41.30840 | Lower Green-Little Snake    | 14050004 | Cheyenne         |
| 699 |                               | Oversample | -108.83980 | 41.10964 | Lower Green-Little Snake    | 14040109 | Cheyenne         |
| 700 | Henrys Fork                   | Oversample | -109.99544 | 41.04210 | Lower Green-Little Snake    | 14040106 | Cheyenne         |

|     |                    |            |            |          |                          |          |          |
|-----|--------------------|------------|------------|----------|--------------------------|----------|----------|
| 701 | Bitter Creek       | Oversample | -109.17453 | 41.59446 | Lower Green-Little Snake | 14040105 | Cheyenne |
| 702 | Bitter Creek       | Oversample | -108.52324 | 41.49476 | Lower Green-Little Snake | 14040105 | Cheyenne |
| 703 | Little Snake River | Oversample | -107.67782 | 41.03430 | Lower Green-Little Snake | 14050003 | Cheyenne |
| 704 | Gooseberry Creek   | Oversample | -109.23435 | 41.16679 | Lower Green-Little Snake | 14040106 | Cheyenne |
| 705 |                    | Oversample | -109.42920 | 41.48707 | Lower Green-Little Snake | 14040106 | Cheyenne |
| 706 | Coyote Creek       | Oversample | -108.82667 | 41.09183 | Lower Green-Little Snake | 14040109 | Cheyenne |
| 707 | Savery Creek       | Oversample | -107.28995 | 41.27539 | Lower Green-Little Snake | 14050003 | Cheyenne |
| 708 | Upper Marsh Creek  | Oversample | -109.51501 | 41.15509 | Lower Green-Little Snake | 14040106 | Cheyenne |
| 709 | Muddy Creek        | Oversample | -107.48492 | 41.46841 | Lower Green-Little Snake | 14050004 | Cheyenne |
| 710 | Battle Creek       | Oversample | -107.21706 | 41.06947 | Lower Green-Little Snake | 14050003 | Cheyenne |
| 711 | Muddy Creek        | Oversample | -107.45381 | 41.44434 | Lower Green-Little Snake | 14050004 | Cheyenne |
| 712 | Poison Creek       | Oversample | -110.13869 | 41.06009 | Lower Green-Little Snake | 14040106 | Cheyenne |
| 713 | Bitter Creek       | Oversample | -108.77529 | 41.67535 | Lower Green-Little Snake | 14040105 | Cheyenne |
| 714 | Muddy Creek        | Oversample | -107.66438 | 41.15328 | Lower Green-Little Snake | 14050004 | Cheyenne |
| 715 | Gap Creek          | Oversample | -109.03447 | 41.22755 | Lower Green-Little Snake | 14040105 | Cheyenne |
| 716 | Henrys Fork        | Oversample | -109.90138 | 41.05762 | Lower Green-Little Snake | 14040106 | Cheyenne |
| 717 | Roney Creek        | Oversample | -110.52001 | 42.06382 | Upper Green-New Fork     | 14040101 | Lander   |
| 718 | Boulder Creek      | Oversample | -109.70713 | 42.83643 | Upper Green-New Fork     | 14040102 | Lander   |
| 719 | North Horse Creek  | Oversample | -110.32054 | 42.92009 | Upper Green-New Fork     | 14040101 | Lander   |
| 720 | Fontenelle Creek   | Oversample | -110.17825 | 42.09072 | Upper Green-New Fork     | 14040101 | Lander   |
| 721 | Rock Creek         | Oversample | -110.10929 | 43.25500 | Upper Green-New Fork     | 14040101 | Lander   |
| 722 | Willow Creek       | Oversample | -109.92700 | 43.01211 | Upper Green-New Fork     | 14040102 | Lander   |
| 723 |                    | Oversample | -110.20589 | 42.56357 | Upper Green-New Fork     | 14040101 | Lander   |
| 724 | New Fork River     | Oversample | -109.85910 | 42.59662 | Upper Green-New Fork     | 14040102 | Lander   |
| 725 | Marsh Creek        | Oversample | -110.02353 | 43.06853 | Upper Green-New Fork     | 14040102 | Lander   |
| 726 |                    | Oversample | -110.13313 | 42.88842 | Upper Green-New Fork     | 14040101 | Lander   |
| 727 | South Piney Creek  | Oversample | -110.39291 | 42.52339 | Upper Green-New Fork     | 14040101 | Lander   |
| 728 | Green River        | Oversample | -110.03032 | 42.52224 | Upper Green-New Fork     | 14040101 | Lander   |
| 729 | Green River        | Oversample | -109.95547 | 42.67120 | Upper Green-New Fork     | 14040101 | Lander   |
| 730 | Beaver Creek       | Oversample | -110.13185 | 42.99367 | Upper Green-New Fork     | 14040101 | Lander   |
| 731 | Green River        | Oversample | -110.14104 | 42.34037 | Upper Green-New Fork     | 14040101 | Lander   |
| 732 | Cottonwood Creek   | Oversample | -109.47502 | 42.72413 | Upper Green-New Fork     | 14040102 | Lander   |
| 733 | New Fork River     | Oversample | -109.75671 | 42.76383 | Upper Green-New Fork     | 14040102 | Lander   |
| 734 |                    | Oversample | -110.23764 | 42.20699 | Upper Green-New Fork     | 14040101 | Lander   |

|     |                          |            |            |          |                      |          |        |
|-----|--------------------------|------------|------------|----------|----------------------|----------|--------|
| 735 |                          | Oversample | -110.08980 | 42.88301 | Upper Green-New Fork | 14040101 | Lander |
| 736 | Green River              | Oversample | -109.94779 | 42.58555 | Upper Green-New Fork | 14040101 | Lander |
| 737 |                          | Oversample | -110.02377 | 42.87639 | Upper Green-New Fork | 14040101 | Lander |
| 738 | East Fork River          | Oversample | -109.58868 | 42.70855 | Upper Green-New Fork | 14040102 | Lander |
| 739 | South Cottonwood Creek   | Oversample | -110.30360 | 42.78396 | Upper Green-New Fork | 14040101 | Lander |
| 740 | Cottonwood Creek         | Oversample | -109.51632 | 42.71139 | Upper Green-New Fork | 14040102 | Lander |
| 741 | Gypsum Creek             | Oversample | -110.00014 | 43.20955 | Upper Green-New Fork | 14040101 | Lander |
| 742 | Horse Creek              | Oversample | -110.20214 | 42.93084 | Upper Green-New Fork | 14040101 | Lander |
| 743 | Green River              | Oversample | -110.01075 | 43.18535 | Upper Green-New Fork | 14040101 | Lander |
| 744 | West Meadow Canyon Creek | Oversample | -110.12292 | 42.54671 | Upper Green-New Fork | 14040101 | Lander |
| 745 |                          | Oversample | -109.97542 | 42.81253 | Upper Green-New Fork | 14040101 | Lander |
| 746 | La Barge Creek           | Oversample | -110.41405 | 42.27524 | Upper Green-New Fork | 14040101 | Lander |
| 747 |                          | Oversample | -110.02874 | 42.69361 | Upper Green-New Fork | 14040101 | Lander |
| 748 | Dutch George Creek       | Oversample | -110.45970 | 42.11573 | Upper Green-New Fork | 14040101 | Lander |
| 749 | South Cottonwood Creek   | Oversample | -110.56858 | 42.75627 | Upper Green-New Fork | 14040101 | Lander |
| 750 | Crow Creek               | Oversample | -109.96963 | 43.38178 | Upper Green-New Fork | 14040101 | Lander |

Appendix C – Flow chart for Qa/Qc process.

